Alan Turing Pt1

Article · October 2019

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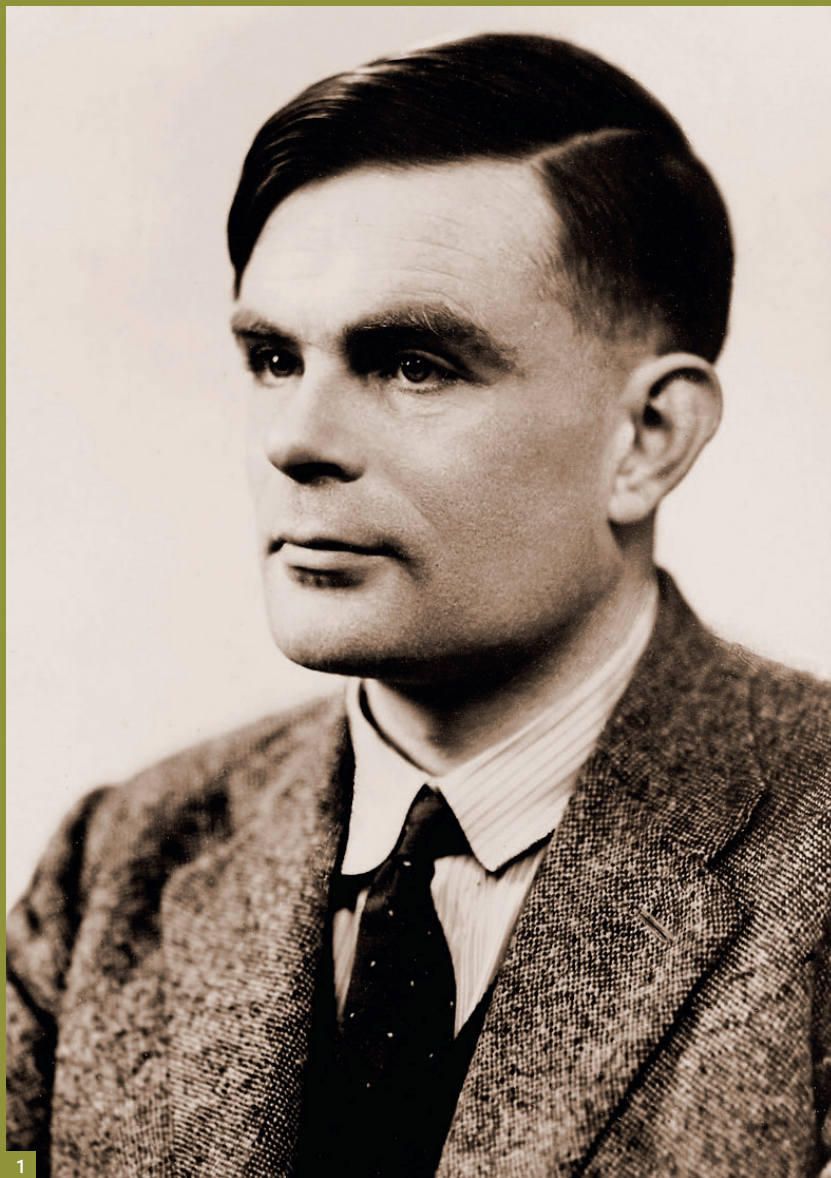**Some of the authors of this publication are also working on these related projects:**

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1

Alan Turing: Misunderstood Genius (Part I)

Scott Caldwell begins a two-part article on the life and achievements of Alan Turing, his early life and education, his work at Bletchley Park, and the factors that shaped his personality.

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Alan Mathison Turing was born on 23rd June 1912 in Warrington Lodge nursing home, in the West London district of Paddington. Turing had a unique personality, and he was described by many friends, teachers, and colleagues as a genius with a 'lightning-intellect'. The name 'Turing' originates from Scotland, with the final letter 'g' added by Sir William Turing of Aberdeenshire, during the reign of King James VI.

At the time of writing, Alan Turing has just been chosen as the face of the new UK £50 banknote. https://tinyurl.com/y2klrxwv

Early Years and Family

Alan Turing and older brother John did not have a close relationship with their parents, and there was a period of considerable absence in their early childhood. Their father, Julius Mathison Turing held a prominent position as an assistant administrator and magistrate in the Government of the Madras Presidency, until his return home in 1926. Their mother, Ethel Sara Turing (née Stoney) was of Irish birth, yet she had also spent much of her childhood in India, where her father was employed as a chief engineer of the Madras Railway.

Turing was a child of the British Empire. The brothers were initially entrusted into the care of a retired Colonel in Hastings, who pushed the boys to play war games. This, he believed, suited their gender and their middle-class position in the society of the time. His views were strongly influenced by contemporary attitudes to Britain's involvement in the First World War.

On a rare visit home, his mother reported that *"Alan seemed frequently disturbed. He will in a moment cry with rage and attempt to hold his breath, and in the next moment he will laugh at his tears, saying look at my big tears, squeeze his eyes and say 'Ah', with his mouth wide open trying to squeeze out more tears for fun"*.

In 1922, the young Turing was enrolled in a preparatory boarding school, Hazelhurst in Sussex. Many associates throughout his life remarked that he seemed locked in a private world of scientific inquiry. In the midst of the General Strike in 1926, Turing was registered at Sherborne School, a classic English public school, structured along lines of discipline and respect. His early school reports offered few hints of his gen-

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uine and unique academic brilliance.

His English school report, in particular, was rather damning in its assessment of his academic achievement: *"I can forgive his writing, though it is the worst I have ever seen, and I try to view tolerantly his unswerving in-exactitude and slipshod dirty work, inconsistent though such in-exactitude is in a utilitarian, I cannot forgive the stupidity of his attitude towards sane discussion on the New Testament"*. It concluded with the following assessment: *"bottom of the class"*. His science report was a slight improvement, and it was suggested that his *"knowledge, though scrappy, was said to be considerable"* when compared to that of his fellow students.

Turing did not actively seek to be a rebel, yet his headteacher had already reached this conclusion and wrote that he was. *"the sort of boy who is bound to be a problem for any school or community"*.

Turing's University Life

Turing enrolled at Kings College, Cambridge, studying for a degree in Mathematics between 1931 and 1934. University life clearly suited him well, offering the right balance of freedom and discipline. Despite his shy personality, he took up rowing and was a willing participant in the *College Trial Eights* in 1931, 1933, and 1934. His dissertation proved the existence of the Central Limit Theorem, resulting in his election to a fellowship of the school upon graduation.

In 1938, Turing obtained a PhD from Princeton University (USA), based on mathematical logic and reasoning, This laid the foundations for his later work in computer science and artificial intelligence. He worked alongside Professor Alonzo Church (1903-1995), a leading academic in mathematical logic and reasoning.

A Collaboration with Poland

On July 24th – 26th 1939, near Pyry in the Kabackie Woods, a historic meeting had taken place, involving a delegation from the three post-war allies, Britain, France, and Poland. The Polish side consisted of three cryptologists, Rejewski, Roycki, and Zygalshi. They were joined by two additional officers from the Polish Cipher Bureau, Langer, and Ciki. The French party consisted of Gustave Bertrand and Henri Braquenie, while British interests were represented by Alastair Denniston, Alfred D. Knox, and one other officer (most likely Humphrey Smith). In the course of the clandestine gathering, a most extraordinary
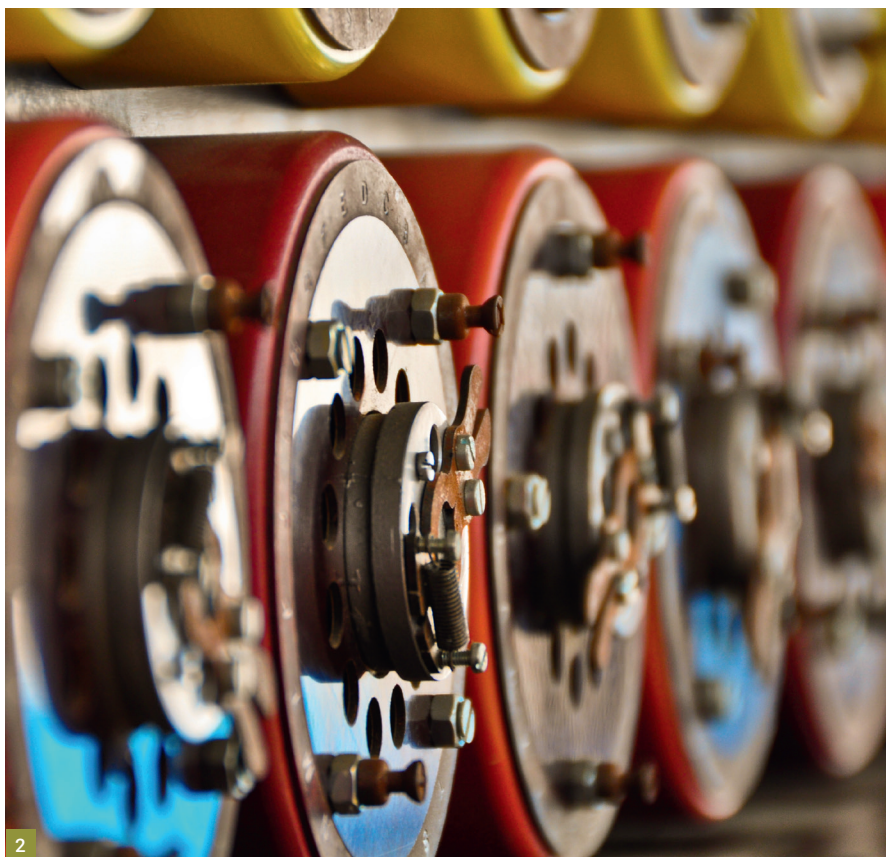
event took place – the Polish agents handed over two duplicates of a reconstructed Enigma machine to their British and French counterparts.

https://tinyurl.com/y3drhy35

The Outbreak of the Second World War

At the outbreak of hostilities on Sunday, 3rd September 1939, Turing was promptly appointed as a temporary civil servant within the bureaucracy of The Foreign Office. The need for Turing's remarkable intellect soon became apparent, when – in response to the commencement of hostilities – the German High Command changed the format of its cypher systems on a daily basis. This simple security measure made the task of decoding them much more complex, requiring collaboration from the wider academic community.

At Bletchley Park

The mansion house at Bletchley Park was a unique building – a mixture of mock-Tudor styles and Gothic architecture. It reflected the eccentric personality of Sir Herbert Leon (1850-1926), a famous 19th Century stockbroker from London. The site selected for his country home was Bletchley a small town located within the county of

Fig. 1: Alan Turing as a young man.
Fig. 2: Replica of a 'Bombe' device.

Buckinghamshire, approximately 50 miles north of London.

The Bletchley Park site was purchased by The War Station of MI6 and its sister organisation, the Government Code and Cypher School. This was essentially the cover name for Britain's elite codebreakers. On 15th August 1939, the main codebreaking contingent moved into their quarters at Bletchley Park.

Their first assignment was to test the working order of vital communication systems. The general working arrangement of the mansion house was based on the following allocation: Top floor was the sole domain of MI6. The vast majority of Government Code and Cypher School, including its departments that represented the army, Royal Navy, and RAF, were allocated the ground floor. This floor also had provision for a kitchen, telephone exchange with direct lines to Whitehall in London, a teleprinter room, and a communal dining room.

Service personnel were instructed to wear civilian clothes and not to inform family or friends of the location of their posting. Mail was addressed to a bogus post office

box number in London. It was censored and forwarded to Bletchley Park via an MI6 courier service.

Mounting Pressure

In October 1941, the staff at Bletchley Park were clearly feeling the pressure. The Battle of the Atlantic was still in the balance, and the supply of vital war materials was a significant cause for concern. There was considerable doubt that the naval version of the Enigma code could ever be broken.

The commanding officer at Bletchley Park, Alastair Guthrie Denniston (1881-1961), commented to the Head of the Naval Section, Frank Birch (1889-1956), *"You know the German's don't mean you to read their stuff, and I don't suppose you ever will"*.

Even Birch privately questioned the progress made at Bletchley Park. In a private memo, he concluded that, *"I am worried about Naval Enigma. I've been worried for a long time, but I haven't liked to say as much. Turing and Twinn are brilliant people, but they are not practical. They are untidy, they lose things, they can't copy outright, and dither between theory and cribbing"*.

This scenario was the catalyst of a letter written by four top Bletchley Park cryptanalysts, including Turing, and was addressed to Winston Churchill (1874-1965). The letter's content was based on an argument for the recruitment of more codebreakers and the provision of more equipment. It read as follows: *"Dear Prime Minister, some weeks ago, you paid us the honour of a visit, and we believe that you regard our work as important. You will have seen that we have been well supplied with the bombes for the breaking of the German Enigma codes. We think, however, that you ought to know that this work is being held up, and in some cases is not being done at all, principally because we cannot get sufficient staff to deal with it. Our reason for writing to you direct is that for months we have done everything that we possibly can through the normal channels. And we despair of any early improvement without your intervention"*.

In a typical Churchillian response, a memo was dictated to his chief of staff that contained the necessary authorisation – *"action this day"*. In an effort to boost the morale of the senior codebreakers, they were summoned to Whitehall to receive an official thank you and a bonus of £200 (£6,000 in today's money).

Recruitment and Crisis

The wheels of the Government's bureaucracy moved with the efficiency Churchill

Fig. 3: A German 'Enigma' machine; the German (bottom-left) reads "close the flap".

demanded. Another interviewing board was despatched to Oxford University in November 1941. Churchill would later recall that, *"the only thing that ever frightened me during the war was the U-Boat peril"*. The War Cabinet had predicted that the UK would tip into starvation if the merchant fleet losses incurred in 1941 remained unchecked in the dawning months of 1942.

By early 1942, the cryptanalysts at Bletchley Park were proving their worth and making a significant contribution to the war effort against the Axis Powers, reflected by the fact that approximately 39,000 intercepted wireless messages per month were decoded.

A Mid-1920s sales brochure proclaimed the following attributes of the Enigma Machine: *"If you have no good coding system, you are always running a considerable risk. Transmitted by cable or without wire, your correspondence will always be exposed to every spy, your letters to being opened and copied, your intended or settled contracts, your offers and important news to every inquisitive eye. Considering this state of thinking, it is almost inconceivable that persons interested in those circumstances should delay securing themselves better against such things – yet, ciphering and description has been a troublesome art hitherto. Now, we can offer you our machine, being a universal remedy for all those inconveniences"*.

The German military (*Wehrmacht*) had absolute faith in the functionality of the Enigma machine to remain 'unbreakable'. Its elaborate configuration of three rotators

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and a plugboard enabled a vast number of possible encoding positions for each alphabetical letter. It is estimated that the possible number of encoding positions equated to about 5,000 billion, trillion, trillion, trillion, trillion, justifying the Germans' perceived faith over confidence.

The Bombe

The British version of the Bombe was conceived by both Turing and his colleague, Gordon Welchman (1906-1985). Originally, the Bombe was to be constructed according to plans devised by Turing and based on the earlier research of the Polish Cipher Bureau.

Welchman, however, had a novel idea for an addition to the device that resembled a diagonal 'board'. This board greatly augmented the processing capacity of the Bombe. The Bombe was capable of recovering the key settings of the Enigma machine, even if the German operators would drop the double encryption of the message key at the beginning of each message.

Its name was also a variation of the Polish set that was universally known as the *Bomba*, used regularly before the outbreak of hostilities. The *Bomba* exploited the fact that the same message indicator was transmitted twice at the start of the message, a major weakness with the Enigma encryption. On 1st May 1940, the

Fig. 4: The keyboard of an 'Enigma' machine.
Fig. 5: A recent book title (See *Book Review*).
**Fig. 6: This book looks at Aland Turing's legacy.**

German military identified the security risk of double-encipherment of the message indicator and instructed all Enigma operators to stop this practice immediately. This single act rendered the Bomba redundant overnight, at a time when Britain was fighting for its very existence, in the build-up to possible invasion.

In late 1942 and early into 1943, Alan Turing was posted to the United States, acting as a liaison to American codebreakers. He visited their intelligence operations at OP-20-G, the Naval Computing Machine Laboratory, located at the National Cash Register Company in Dayton, Ohio, and Bells Labs. He was primarily interested in the research and development work undertaken there on speech-enciphering technology.
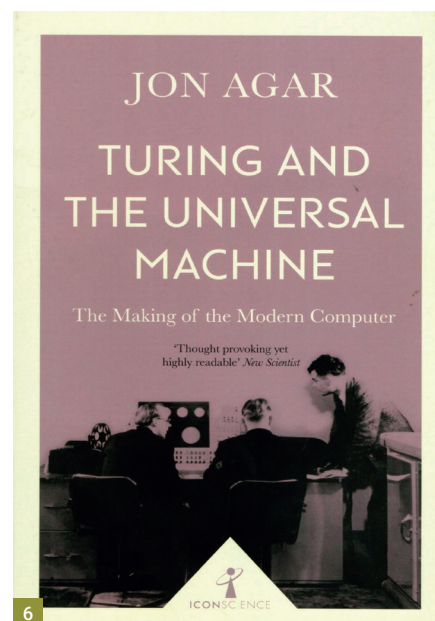
The Battle of the Atlantic

The United Kingdom was a maritime trading nation, requiring imports of food and war materials. However, the *Kriegsmarine* conducted a campaign of unrestricted submarine (*U-Boot*) warfare in a desperate attempt to make them sue for peace.

Early in 1936, the 'Third Reich' had instructed both the Telefunken and Lorenz
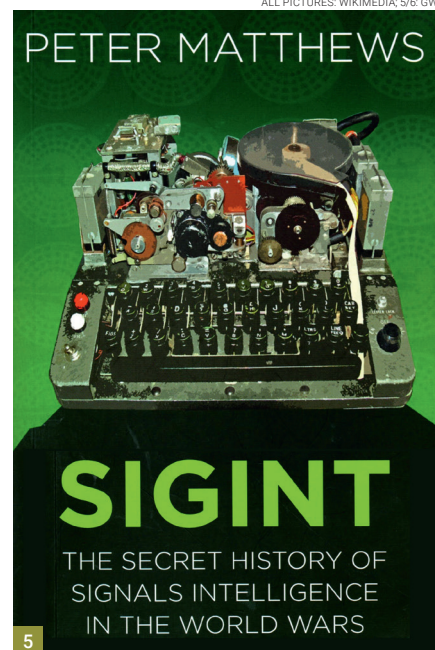
companies to conduct research and design a system that was capable to detecting both ships and aircraft, utilising radio signals that would not be adversely affected by atmospheric conditions. In 1940, this system was finally completed and covertly operated under the code name *Elektra-Stone*. Coverage was provided through the installation of six radio-detection stations; these were strategically placed along the coastlines of occupied Northern Europe. The Fascist dictatorship in Spain even consented to the installation of two stations along their coastline.

The plotted navigation coordinates were transmitted, under Enigma encryption, to

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Fig. 7: A Good Friend: Joan Clarke (1917-1996).

both the *Kriegsmarine* and the *Luftwaffe*, who worked together, in an effort to intercept the merchant convoys. The system continued to be operated until the advent of satellite tracking systems in 1980, providing navigational assistance and calculating distress positions.

One of the stations was located in the Spanish town of Arneiro and remained structurally intact, until a storm damaged it in February 2006. The station's real estate comprised of three separate buildings: a building for the operation of the radio equipment, a building with a kitchen and sleeping accommodation, and a building that housed the electrical generators. The antennas were suspended by three 122-metre high towers that were separated by a distance of 2,823 metres.

The Royal Navy utilised its proprietary sonar system named *Asdic*, which had a limited range of 2,000 yards. This was useless in the vast expanses of the North Atlantic – approximately 41 million square miles.

The *Kriegsmarine's* Enigma set was subtly different from the *Wehrmacht* and *Luftwaffe* sets, due to the installation of the M3 naval key. The M3 key had been notoriously difficult for the British code breakers at Bletchley Park to decipher. However, the early months of 1941 brought about a remarkable change of luck for the British codebreakers. On 3rd and 4th March 1941, a total of seven German transport ships were raided and sunk during a Royal Navy attack near the Lofoten Islands. Most importantly, a boarding party from the destroyer *Somali* captured an abridged setting with its distinct message key.

The prized capture of a complete, and fully-operational, Enigma machine occurred on 7th May 1941. When a Royal Navy patrol party intercepted the German weather patrol trawler *München*. On 9th May 1941, the submarine U110 was ambushed and forced to the surface, allowing her crew to escape from the ferocious British attack. The commander of U110 was Kapitänleutnant Fritz-Julius Lemp (1913-1941) who decided to return to the U-boat to destroy the cypher machine and codebook as she was sinking too slowly, in position 60°N 33W just east of Cape Farewell.

There was a significant risk that a boarding party from *HMS Bulldog* would discover them before they could be destroyed, preventing them from falling into enemy hands. Lemp was allegedly shot dead in the water before he could reach the radio room on U110. The British subsequently denied this claim, and a number of his crew even suggested that he simply gave up the fight, throwing up his arms in the air and sinking below the surface, in an apparent act of suicide. His credibility and reputation would have been discredited in the *Kriegsmarine*, by allowing his cypher machine and codebook to be seized – a major intelligence coup by the British.

Private Life

As a homosexual, Turing was always in danger of facing criminal prosecution at the time; unfortunately, an injudicious liaison turned potential into reality. Turing was charged in relation to gross indecency contrary to Section 11 of the *Criminal Law Amendment Act 1885*. His subsequent criminal record led to a premature end of his work within British intelligence and restricted his foreign travel, particularly to the United States.

Turing's sudden death on 7th June 1954, deprived society of a great and unique mind that was at the pinnacle of its intellectual ability. For all his academic brilliance he never posed as a 'high-brow' character, and his personality was viewed as rather shy when interacting with people he did not know or relate to.

Turing was not concerned with his physical appearance; one colleague at Bletchley Park remarked that he resembled a tramp. He would often be seen working, dressed in his pyjamas, or with trousers that were held in position by a striped necktie instead of a belt. His hair was unkempt, and he would not shave without his old electric razor. Though Turing did not smoke, his teeth were permanently yellow and he had a habit of biting his fingernails to such an extent that his fingertips were covered in scars.

However, Turing did manage to attract the attention of a young female mathematician, by the name of Joan Clarke (1917-1996). They began to socialise, spending a lot of time together, going to the cinema, playing tennis, and chess, while debating the recurring nature of the Fibonacci Sequence. Remarkably, Turing had admitted to Joan that he had sexual feelings for other men, although she did not initially think that this was a major issue, and they soon became engaged.

It was quite common for gay men to marry, in an attempt to 'conform' to social norms and gain a measure of respectability. Their courtship moved at a fast pace, they exchanged rings, visited each other's parents, and continued to enjoy their mutual and unique friendship. However, within a period of six months, Turing began to have serious doubts about the long-term suitability of marriage; this played on his mind, forcing him to call off their planned wedding. However, they would remain, great friends for the rest of Turing's life.

Turing's personality displayed a number of eccentric traits, among the most noticeable of which was his habit of riding his bicycle around Bletchley Park with his gas mask on. It was also a constant source of enjoyment to his colleagues when they used to steal his cup that was permanently chained to the radiator in Hut 8; their motive was purely to tease him. Turing's shyness remained a constant trait throughout his life, and colleagues frequently remarked on his habit of concluding a conversation by sidling silently out of a room with his eyes lowered, murmuring his thanks.

[*Part Two of this article will be published in the January 2020 issue of RadioUser* – ***Ed***.]

Read On...

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